4- Amputations

Above knee amputation:

- Angiography + direct arterial surgery (bypass).
- Amputation of limb till above the knee.

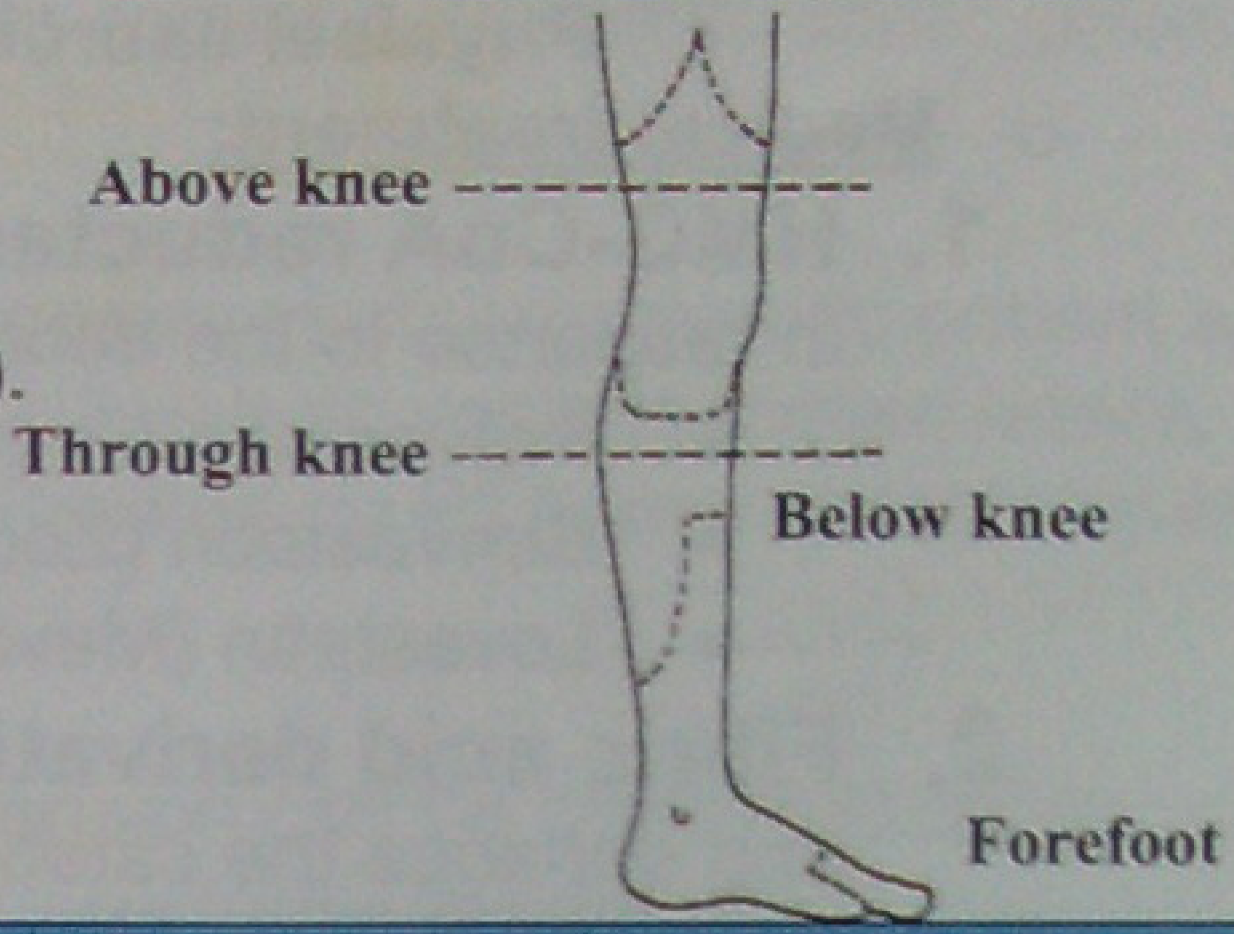
Through knee amputation:

- Angiography + direct arterial surgery (bypass).
- Level of amputation is through the knee joint.

Below knee amputation:

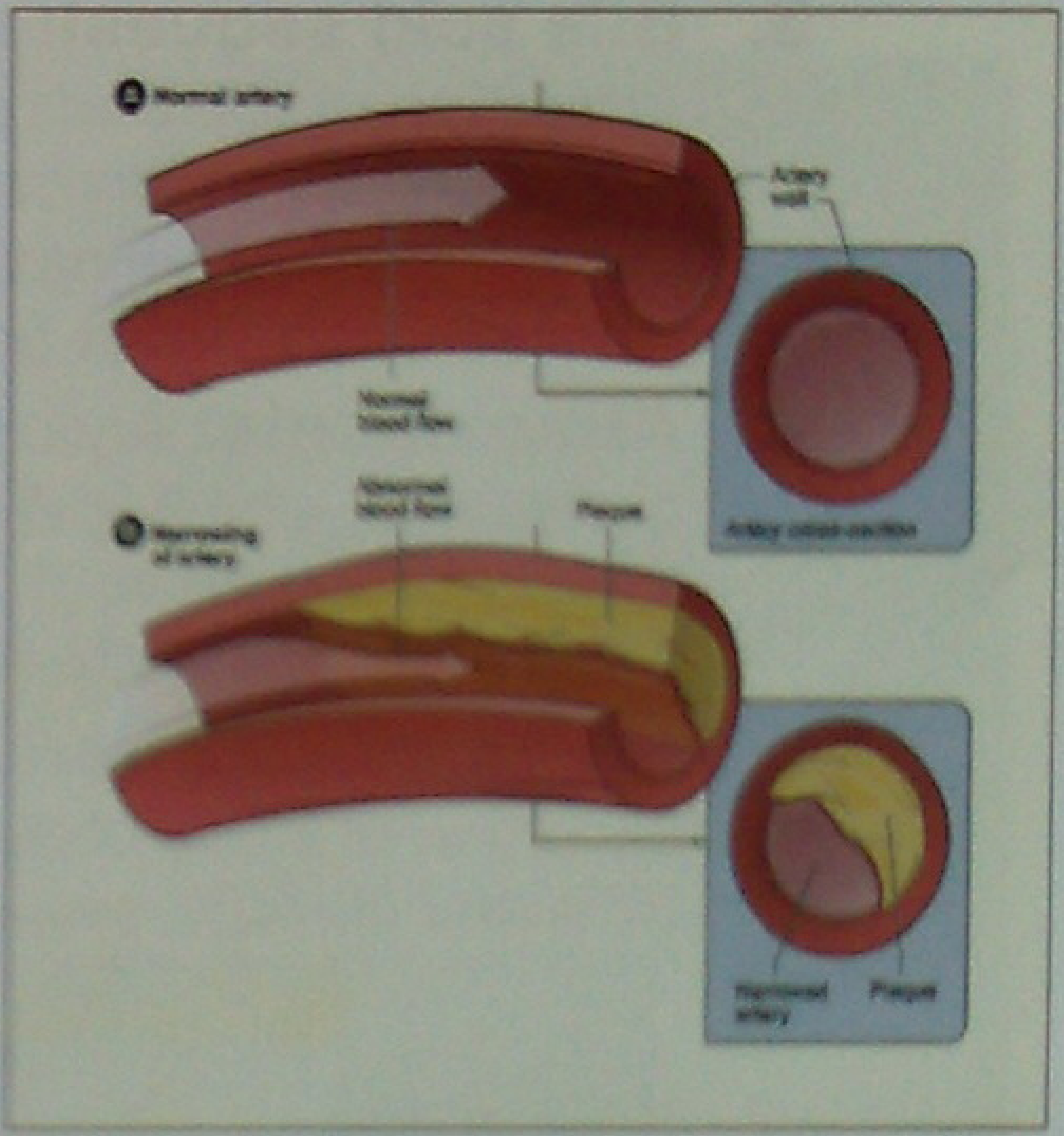
- Angiography + direct arterial surgery (bypass).
- Amputation → below knee.

Forefoot amputation.



More Details about Atherosclerosis

- **Atherosclerosis is a disease of large and medium-sized muscular arteries and is characterized by:**
  1. Endothelial dysfunction,
  2. Vascular inflammation,
  3. **The buildup** of lipids, cholesterol, calcium, and cellular debris within the intima of the vessel wall.
     - **This buildup** results in:
       1. Plaque formation.
       2. Vascular remodeling.
       3. Acute and chronic luminal obstruction.
       4. Abnormalities of blood flow.
       5. Diminished oxygen supply to target organs.



⇨ **Risk factors:**

- Hyperlipidemia
- Hypertension
- Diabetes mellitus
- Smoking

⇨ **Pathology:**

- Atherosclerosis usually affects large and medium-sized arteries.
- The process may begin in childhood and often progresses when people grow older.
- The damage begins in the innermost layer of the artery *(endothelium)*.

⇨ **Pathogenesis:**

- Plaques *(fats, cholesterol, platelets, cellular waste products, calcium and other substances)* are deposited in the damaged endothelium.
- These deposits further stimulate the cells in the artery walls to produce factors that promote the proliferation of smooth muscle cells and the accumulation of lipids.
- As a consequence, the artery is progressively stenosed or occluded

⇨ **Treatment:**

- The prevention and treatment of atherosclerosis requires control of the known modifiable risk factors for this disease. This includes the medical treatment of hypertension, hyperlipidemia, diabetes mellitus, and cigarette habituation.
  - ○ **Non pharmacological treatment:**
    - **Diet**: The primary treatment of LDL hypercholesterolemia is dietary and includes restriction of caloric intake, saturated fats, and cholesterol.
    - **Physical exercise.**
  - ○ **Medical treatment:**

1. **HMG-CoA reductase inhibitors:** this group up-regulates LDL receptors in response to the decrease in intracellular cholesterol.
    - Pravastatin (Pravachol) :10-40 mg/d PO hs
    - Simvastatin (Zocor): 5-80 mg/d PO hs
    - Lovastatin (Mevacor, Altocor)
2. **Fibric acid derivatives:** They increase the activity of lipoprotein lipase and enhance the catabolism of triglyceride-rich lipoproteins, which is responsible for an increase in the HDL cholesterol fraction
    - Fenofibrate (Tricor) :67 mg/d PO
3. **Bile acid sequestrants**: The bile acid sequestrants block enterohepatic circulation of bile acids and increase the fecal loss of cholesterol. This results in a decrease in intrahepatic levels of cholesterol.
    - Cholestyramine (Questran): 4-24 g PO ac divided bid; not to exceed 24 g/d or 6 doses per d
4. **Antioxidants:** Antioxidants are thought to reduce the oxidation of LDL cholesterol, inhibit lipid accumulation in the arterial wall, and improve endothelial function;
    - Vitamin E (Vita-Plus E)
5. **Nicotinic acid derivatives:** Niacin (vitamin B-3) inhibits the hepatic secretion of VLDL cholesterol & lower LDL cholesterol and triglyceride levels by 32% and 20-50%, respectively, and to raise the HDL cholesterol level by 43%.

Atherosclerosis

► Atheromatous Patch:

→ Weak wall → aneurysm
→ Diseased intima → Thrombus → acute ischemia
→ Narrow lumen:
- Chronic ischemia
- Dry gangrene
- 2ry Raynaud's

Other sites of atheromatous occlusive disease

☞ ***Carotid stenosis:*** **see later.**

☞ ***Subclavian artery occlusion:***

- Can cause claudication in an arm or artery to artery embolisation leading to digital ischemia.
- Treatment: the best is PTA. While other options include: endarterectomy or bypass. Sometimes it is associated with neck pathology as cervical rib that should be corrected at time of artery repair.

Subclavian steal phenomenon

- Thrombosis on top of atherosclerosis affecting the 1st part of subclavian artery before origin of vertebral artery.
- So the vertebral artery provide a collateral circulation by reversing its direction of flow. This may cause periods of cerebral ischemia due to shift of blood from the basilar artery. However, the classic syndrome of syncopal attacks and visual disturbance associated with arm exercise and diminished BP in affected limb is rare, asymptomatic reversal of flow is much more common. In symptomatic patient, PTA or operation is indicated.

Enteric artery occlusion

- Can cause pain after eating with no obvious diagnosis in atherosclerotic patient with weight loss. This may be due to occlusion of 2 or 3 enteric vessels (celiac artery, SMA, IMA). This "intestinal claudication" can be treated by PTA, enarterectomy or bypass after exclusion of all other diagnosis.

Renal artery stenosis

- Can cause hypertension or renal failure. Hypertension can be controlled by drugs but RF require either PTA or operation as endarterectomy, bypass or revascularization.

N.B.

⇒ **- The word "claudication" comes from**

1. The Latin "claudicare" meaning to limp.
2. The roman emperor Claudius walked with a limp, which was possibly due to poliomyelitis.

⇒ **DD of claudicating pain**

1. **Osteoarthritis:** pain on the first step
2. **Lumbar prolapse:** pain not relieved by standing still.
3. **Venous claudication:** ↑ on prolonged standing & ↓ on lying flat.
4. **Flat foot:** pain on standing or walking (due to pressure on plantar nerves).

⇒ **Factors affecting claudication distance:**

1- Speed of walk (high speed decreases it).
2- The presence of hills or soft floor (reduces it).
3- Upstairs movement.
4- Degree of ischemia.
5- General health such as anemia or heart failure.

⇒ **Arm claudication:**

- It may occur in upper limb in subclavian, axillary, brachial artery obstruction. The pain being brought on by such activities e.g. writing or manual labour.

⇒ **There is also venous claudication, resulting from inadequate venous drainage.**

- Warmth stimulates tissue metabolism→ ↑ischemia.
- Patient tends to uncover his limb (↓ metabolism).& put it in dependant position (↑ blood supply). – Rubbing of dorsum of foot

- The acutely ischemic limb is frequently paralyzed and without sensation but chronic ischemia does not cause paralysis, but hyperesthesia is common especially in those areas of skin on borderline of gangrene.

⇒ **Factors affecting the severity:**

1. Size of the vessel occluded.
2. The collaterals available for blood flow.

⇒ **Signs of impending limb gangrene:**

1. Rest pain.
2. Edema.
3. Color changes.
4. Hyperthesia.
5. Ankle pressure < 30 mmHg.
6. With or without ulceration.

⇒ **Degree of ischemia can be determined by:**

1. Degree of pain (claudication distance). Claudication distance <50m and rest pain → severe ischemia.
2. Color changes: fixed color changes → severe ischemia.
3. Trophic changes.
4. Capillary circulation (sluggish > 2sec).
5. Venous filling: prolonged > 2min → severe ischemia.

Relationship of clinical findings to site of disease

Symptoms and signs can determine

1. The site of major arterial obstruction.
2. The presence of an additional obstruction i.e. signs of iliac artery obstruction and ulceration of the foot suggest an additional obstruction, as collateral circulation around an isolated iliac artery obstruction is usually excellent, such severe features indicate a 2nd obstruction typically in the femoral or poplitial artery.
3. Prognosis as the best result from surgery are obtained by operation on the large vessels which allow high volume of blood flow through bypass graft.

The level of ischemia can be determined by:

1. Site of claudication.
2. Color changes.
3. Trophic changes.
4. Temperature changes.
5. Level of pulse.

Q

Diabetic Foot

Definition

- Term used to describe complex pathology in a diabetic patient's foot. It is related to duration and control of disease.

Presentation

- Neuropathic ulcer.
- Diabetic foot infection.
- Diabetic vasculopathy.
- Mixed types.
- Gangrene.

○ Neuropathic Ulcer

A. **Causes:**

- Patient is unaware of his foot →foot injury → neglected → ulcer

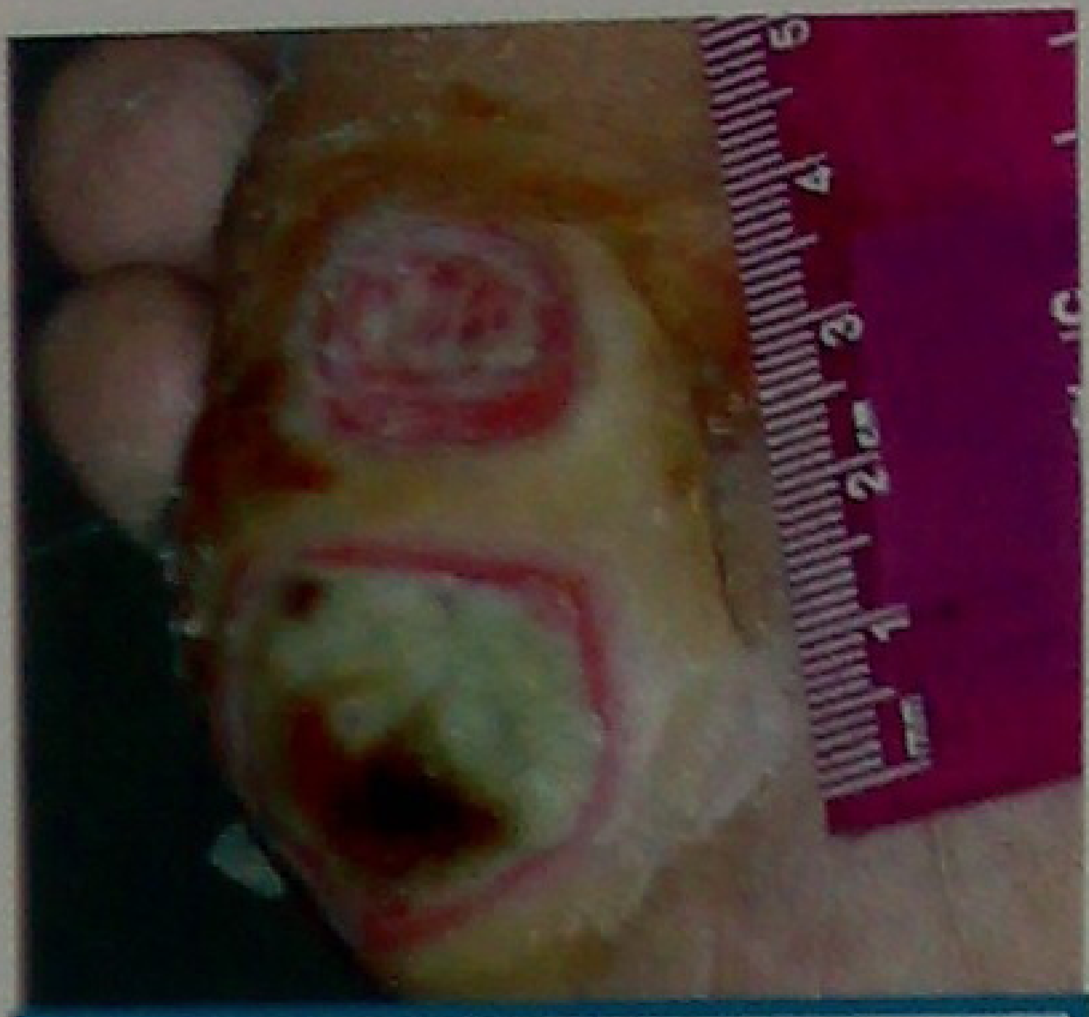
Kushairi
* ulcer may occur w/out injury:
Myositis of intrinsic foot Mm
→ abnormal bone movt
→ deformity & new pr. area → bursa → inf.
→ abscess → rupture
→ deep ulcer

B. **C/P:**

- Painless, deep ulcer, may reach the bone, at pressure sites e.g heal, ball of the big toe.

C. **Treatment :**

- Control diabetes, Vit. B6, care of foot.



Ulcer in Diabetic Foot

N.B.

- 45% of diabetic foot ulceration are purely neuropathic in origin, 10% are purely ischemic, 45% are of mixed neuroischemic origin.

○ Diabetic Foot Infection

A. **Causes:**

- Decrease resistance (both humoral and cellular immunity are disturbed).
- Glycosylation of tissue.
- +/- ischemia.
- Neuropathy.

B. **C/P:**

- Severely swollen limb, red, hot & tender.
- Pus loculus , tissues becomes dark and slough .
- May spread →osteomyelitis, septic shock.

C. **Treatment:**

prophylactic:

- Care of patient: control diabetes.
- Care of foot: avoid trauma, good hygiene.

Curative:

- Hospitalization.
- Broad-spectrum antibiotics.
- Drainage of pus, debridement of dead tissue, if gangrenous → amputation.

Diabetic Vasculopathy

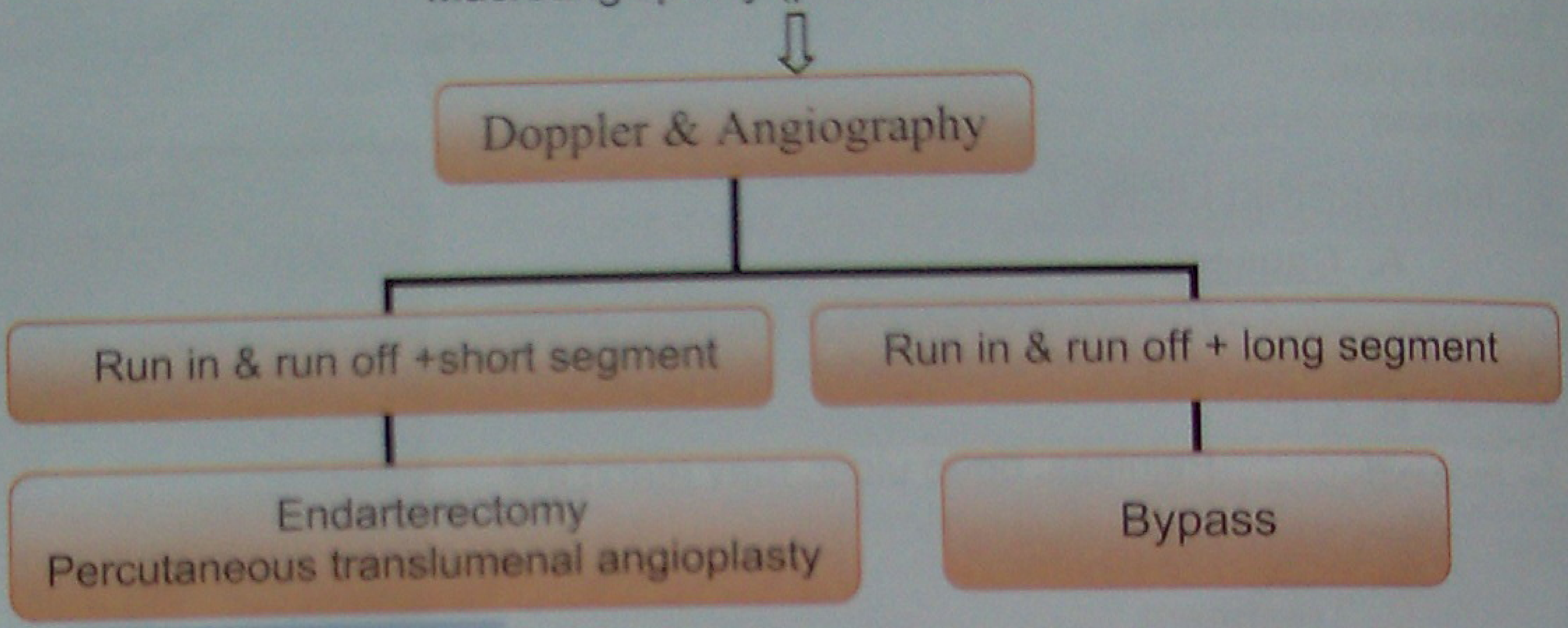
A. **Cause**

- Macroangiopathy (acceleration of atherosclerosis).
- Microangiopathy due to deposition of glycogen and lipids on the walls blood vessels.

B. **C/P:** of chronic ischemia (see before).

C. **Treatment:**

- Microangiopathy: (all pulses are felt, no bleeding from cut wound) →surgical debridment, antibiotics, skin flap to promote healing.
- Macroangiopathy (pulse is not felt).


Doppler & Angiography
Run in & run off +short segment
Run in & run off + long segment
Endarterectomy
Percutaneous translumenal angioplasty
Bypass

Mixed Type

- There is severe infection in addition to major vascular and neuropathic affection

Gangrene

- Wet gangrene: on top of infection.
- Dry gangrene on top of chronic ischemia.
- (C/P & TTT see gangrene).

NB:

- **Risk factors for ulceration include:**
  - Previous ulceration.
  - Neuropathy (stocking, distribution loss and Charcot's joints).
  - Peripheral arterial disease (more commonly affects the below knee calf vessels(trifurcation), which are frequently higher calcified giving rise to false elevated ABPI readings or incompressible vessels).
  - Altered foot shape.
  - Callus indicating high foot pressures.
  - Visual impairment.
  - Living alone.
  - Renal impairment
- **Pure neuropathic ulceration:**
  - Warm foot with bounding pulses.
  - Evidence of sensory loss leading to unrecognized repeated local trauma.
  - Normal or high duplex flows.
  - Distended veins.
- **Ischemic/ neuro-ischemic ulceration:**
  - Foot may be cool.
  - Ulcers on toes, heal or metatarsal head.
  - Secondary infection may be present with minimal pus and mild surrounding cellulites.
  - ABPIs may be misleading high.
  - Angiography for suspected critical ischemia due to stenosis.
  - Absent pulses.
  - Duplex ultrasound assessment

Foot Care

- Proper Foot care can prevent many foot problems that threatens the lower extremity so aim of this chapter is to summarize general principles of foot care

The Suspicious Foot (Indications)

1- Diabetic with peripheral neuropathy.
2- Arterial ischemia.
3- Anatomic foot deformity.
4- Dry hyperkeratotic skin (esp. over the heels).

Methods

A- Daily foot care

1- **Washing:**
  - Feet should be washed daily with warm water (never hot) and a mild soap
  - After washing the foot should be thoroughly dried specially between toes (as it is the main site for fungal infection)

2- **Inspection**
  - Foot should be examined for cuts, blisters, ingrown toe nails, discolored skin and doctor should be notified of any problem

3- **Moisturizing the skin:**
  - Via daily application of a Lanolin-base moisturizing lotion to the foot especially the heel
  - These lotions should not be applied between the toes (to avoid fungal infection)

4- **Foot powder:**
  - Antifungal powder is applied between the toes in case of fungal infection or athlete foot

5- **Toe nails:**
  - Should be cut straight, never shorter than the end of the toe (to avoid in grown toe nails) the best time to trim nails is after foot bath when foot is clean and the nail is usually softer

6- **Avoidance of trauma:**

7- **Corns, Calluses:**
  - Usually occur over bony prominence- poorly fitted foot wear is often the cause of them
  - TTT of corns: removing the superficial corn surface with scalpel (never to cut into the deep vascular layer of the corn which may not heel) after the patient use U-shaped felt pad behind the corn to decrease the local pressure, although patient should change his foot wear
  - TTT of Calluses: patient use in lay pads

B- Foot Wear

1- ***Patient with peripheral neuropathy, arterial ischemia should never go bare foot***

2- ***Feet should be kept warm, dry with socks or stockings***
  - Woolen socks are the best in cold weather while cotton socks are the best in warm weather
  - Nylon socks should be avoided
  - Socks should be changed daily

3- ***Shoes:***
  - Should fit comfortably and allow plenty of room for toes
  - Women should avoid pointed shoes that cramps the toes
  - Many diabetic prefer especially made foot wear

Sandals

C- Exercises

- Improves collateral development and maintain normal venous lymphatic flow
- Walking is the safest feet exercise provided shoes fit properly
- Patients with intermittent claudication is instructed to walk slowly, rest when claudication occurs, then continue
- They should gradually ↑↑ their walking distance each week

D- First aid Treatment

- Foot lesions or injuries should be washed with warm water, mild soap then foot is carefully dries
- Apply topical antiseptic ointment (e.g. Bacitracin) to the lesion (avoid strong antiseptic solution such as Iodine)
- Dressing with a clean gauze bandage secured with a roll of gauze
- Next step is to consult the physician.

Chronic Upper Limb Ischemia

- Upper limb ischemia is less frequent than lower limb.

Causes

1. Previous trauma or axillary irradiation leading to arterial stenosis.
2. Subclavian steal syndrome.
3. Takayasu arteritis.
4. Thoracic outlet syndrome.
5. Raynaud's phenomen

Clinical Features

- **Symptoms:** Weakness, cramp, exercise, related pain and distal ischemia.
- Examine bilateral upper limb pulses and BP in both arms.
- Roos test: arm abducted to 90°, hands up with elbows braced backwards, and hands serially clenched (opened for 1-2 min).
- Test is positive if pain or weakness in hand or forearm.
- Addison test.
- Allen test.
- Tinel test.

Investigations

- Cervical spine and thoracic outlet X-ray, CT and MRI.
- Arterial duplex or angiography to exclude proximal arterial lesions.

Treatment

- Treatment of the cause.

Vasospastic Disorders

Definition

1. **Recurrent Ischemic attacks.**
2. **Precipitated by** exposure to cold or emotional stress.
3. **Commoner in** UL & rare in LL.
4. **It consists of:**
    1 Pallor (white) → due to VC.
    2 Cyanosis (blue) → due to sluggish blood flow.
    3 Rubber (red) → due to reflex VD (accumulation of metabolites).

DD

	Raynaud's Disease (1ry)	Raynaud's phenomenon(2ry)
Age & sex	young females (20 - 40 yrs)	Vary according to underlying cause
Cause	- Not exactly know, certain factors are suggested e.g.: 1- Increase sympathetic tone. 2- Psychological instability. 3- Abnormal sensitivity of small arteries and arterioles of hand to cold.	- ***Collagen*** → SLE, scleroderma. - ***Arterial obst.*** → Atherosclerosis, Burger's disease. - ***Nerve injury*** → Thoracic outlet $, carpal tunnel $. - ***Environmental*** → Vibrating tools - ***Drugs*** → beta-blockers.
Distribution	- It affects UL (may affect LL). - It is almost always bilateral. - It is almost always symmetrical.	- May affect LL. - May be unilateral. - If bilateral, it is asymmetrical.
Trophic changes& gangrene	Absent or minimal.	More prominent.
Radial & ulnar pulse	Present.	May be absent.
Follow up	No progression & no evidence of underlying disease.	- Progressive. - manifestations of underlying dis.
Investigation	Should be directed to the suspected underlying cause	
Treatment	Conservative (in early stages) ***Care of patient*** - Stop smoking. - Avoid cold weather. - TTT of anemia if present. ***Care of Hand*** - Good hygiene, dryness of the hand and wear woolen gloves in winter - Hand exercise. ***Drugs:*** *as chonic. Ischemia +* - Vasodilators → phenoxybenzamine, nifedipine. - Baby aspirin (prophylactic for fear of vaso-obliteration). - CCB. Surgery (in severe cases) - Cervicodorsal Sympathectomy. - Immediate results are good, but may recur after one or two years (due to denervation hypersensitivity).	- Treatment of the cause. - Vasodilators and beta-blockers may be used. - No benefit from sympathectomy as there may be: * Vasculitis. * Cryo-antibodies → cause VC in case of lowered blood temp. to 36-36.5^{O} c